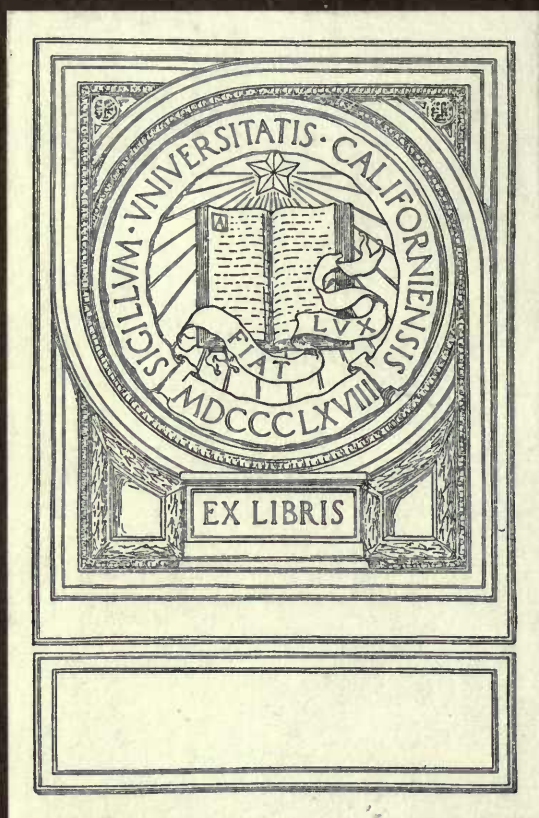


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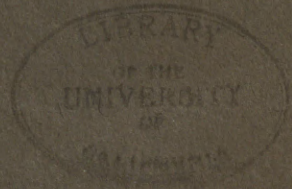


THE CLIMATE OF NANKING DURING THE  
PERIOD 1905-1921

EXCHANGE  
AUG 4 1927

BY  
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## The climate of Nanking during the period 1905-1921.

### 1 General Remarks.

NANKING is situated on the right bank of the Yangtze River, which encircles the west and north sides of the city. It was formerly the seat of the central government of the Chinese Empire during the six dynasties, between the fourth and sixth centuries, before it was made the capital of the new dynasty under the first Emperor of Ming in 1368. His successor, Emperor Yunglo, however, removed the Capital to Peking (which means northern capital), giving to Nanking (southern capital) its present name. In 1911, the city was taken by the revolutionaries, who established here the provisional republican government.

It has at present, a population of 380,000. The city wall, built during the Ming dynasty, is 22 miles in circumference, making it the largest walled city in China. It is 375 miles east of Hankow, and 193 miles west of Shanghai (a port near the mouth of the Yangtze River), and almost at the head of the Yangtze delta.

The local topography around Nanking is varied. On the western side a low range of loess covered hills, 100' to 200' in height, intervened between the city and the Yangtze River. The Purple Mountains, a range of hills just outside of the north-eastern corner of the city wall, however, dominated the city. This range runs from W. SW. to E. NE. It is mainly made up of quartzite, sandstone, and conglomerate; the crest of the range reaches an altitude of 1,450 feet above the ground. Within the city, ponds and small prominences abound; the greater part of the city is however, quite level, and built up by alluvium. Several canals run through the city, they are navigable only at a few stretches.

Nanking is situated on the same latitude as San Diego, Cal., or Jerusalem, Asia Minor. But being on the eastern side of the large continent,

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1) The present paper is based mainly on the data published by Zekawei Observatory, Shanghai, and the Central Observatory, Tokio, Japan. See also note 1 and 2 in the preface.

In order to understand the climate of a place, it is necessary to analyse it into different climatic elements, and discuss each by turn. The following discussion is chiefly based on the data published in the reports of the central observatory of Japan. As the Japanese Observations covered only the period from October 1904 to December 1919, and as the meteorological station of the Southeastern University was not installed until the spring of 1921, there was a gap of little over a year. The station at the Nanking University was recording temperature and rainfall during this period, but it was found that the instruments there were not exposed in a proper way and hence the results could not be utilized. It was then necessary to compare the records of the previous years of Nanking with those of a neighboring station, and find the data on temperature, rainfall, etc., by means of interpolation. The nearest first class station available for that purpose is Nantung, which lies on the left bank of the Yangtze, and about 130 miles down river. Those data, shown in Tables 6 with asterisks (Jan. 1920—April 1921) were computed in this way.

The following table gives the mean monthly and mean annual pressure for Nanking during the period 1905-1915. The readings have been reduced to sea level. As would be expected for a place in the monsoon belt, the pressure is quite high in winter and low in summer.

January	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
71.4	70.0	67.4	63.1	59.7	55.2	54.1	55.1	61.0	66.1	70.0	71.9	63.7

2) J. Hann "Handbuch der Klimatologie" Vol. I, 1911.

north and central China, the annual range of pressure is exceedingly great; thus the annual range of Peking (Lat.  $39^{\circ} 57'N$ ) amounts to 19.1 mm., and that of Lukchun (善都), a place in Gobi, (Lat.  $42^{\circ} 42'N$  Long  $89^{\circ} 42'E$ ) reaches the remarkable sum of 28.9 mm.(3).

When compared with the mean pressure of other places along the same latitude it was found that Nanking has a positive anomaly of 6.7 mm. in January and a negative anomaly of 5.2 mm. in July as shown in the following table.

Table 2. January and July Pressure Anomalies.

	January	July	Year
Nanking	771.4	754.1	763.7
Lat. $32^{\circ}05'$ (4)	764.7	759.3	762.0
Anomalies	+ 6.7	- 5.2	+ 1.7

For a place in the monsoon belt, the pressure controls the other climatic elements to a great extent. Generally speaking, pressure gradient controls wind direction, and wind direction in its turn, controls temperature and precipitation. In Eastern Asia there is a complete reversal of pressure Gradient from winter to summer, and consequently wind direction shifts  $180^{\circ}$  or more in azimuth, and causes great contrasts in temperature conditions and amount of rainfall.

The greatest decrease of the mean monthly pressure takes place in April and June, the greatest increase occurs in September. May and September are the transitional months during which the reversal of pressure gradient takes place.

### 3. Temperature.

Having no high mountains in its vicinity, Nanking is exposed to polar airs in winter and is apt to be invaded by warm and humid airs in summer. "Cold waves," brought here by the northwestern winds in winter, may hold its sway for two or three days at a time, and send the mercury in the thermometer down to  $-10^{\circ}$  C or even less. In summer "hot waves" with a temperature of  $36^{\circ}$  C or over, occur sometimes.

3) See F. Hann "Lehrbuch der Meteorologie" Leipzig 1915 P. 198

4) The figures in this column are calculated from a table given in Hann. Loc. cit. P. 178

The mean annual range of temperature like that of pressure is quite high. As mentioned before, if the continentality of the climate of Nanking be judged by the mean annual range alone, it will have a degree of continentality of 75. The Mean monthly for January is much too low for its latitude and mean monthly for July a little too high.

Table 3. Anomalies for January and July mean monthly temperatures of Nanking.

	January	July	Year
Nanking	2.7°C	27.4°C	15.2°C
Average for Lat. 32°05'(5)	11.8°	26.7°	18.9°
Anomalies	-9.1°	+0.7°	-3.7°

From Table 3, it is evident that the negative anomaly for the mean monthly temperature of January is exceedingly great. This is not only true for Nanking but is characteristic of all places in North and Central China,<sup>(6)</sup> and constitutes the earmark of the climate of northeastern Asia.

According to A. J. Herbertson<sup>(7)</sup>, the whole subtropical belt, in which Nanking is situated, can be divided into four climatic provinces, viz: (a) Eastern side of the continent or Chinese type, (b) western side of the continent or Mediterranean type, (c) continental interior or Turan type, and (d) interior plateau or Iran type. According to this scheme, Nanking naturally falls into the first province. It will be interesting to select a few stations from each of the above provinces and compare their temperatures with those of Nanking.



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- 5) The figure in this column are calculated from a table given in Hann's "Lebebuch der Meteorologie" P. 142  
 6) Central China means here the Yangtze Valley and N. China, the valley of the Yellow River and Manchuria.  
 7) A. J. Herbertson "Map of Natural Regions" Geographical Journal 1905 pp. 300-309. Also see R. Dec. Ward "Climate" P. 72.

TABLE No. 4

Stations	Latitude	Altitude	Jan.	April	July	Oct.	Year	Range	Contin- entality,
PROVINCE (A)									
Nanking	32° 05' N	28.9 <sup>(8)</sup> M.	2.7°	14.3°	27.4°	17.1°	15.2°	24.7°	77
Shanghai	31° 32' N	7	3.2°	13.4°	26.9°	17.4°	15.0°	23.7°	75
Hankow	30° 35' N	37	4.4°	15.9°	28.5°	18.4°	16.7°	24.1°	79
Montgomery, Ala.	32° 24' N <sup>(9)</sup>	68	8.8°	18.3°	27.8°	19.3°	18.4°	18.9°	59
Savannah, Ga.	32° 05' N <sup>(10)</sup>	20	9.9°	18.2°	26.9°	19.0°	18.6°	17.0°	53
PROVINCE (B)									
San Diego, Cal.	32° 43' N	27M.	12.0°	14.6°	19.5°	17.3°	15.9°	8.2°	25
Funchal, Made- ira.	32° 38' N <sup>(10)</sup>	25	15.5°	16.4°	21.4°	20.3°	18.4°	7.1°	22
PROVINCE (C)									
Yuma, Ariz.	32° 45' <sup>(10)</sup>	43M.	12.3°	21.0°	38.1°	22.8°	23.3°	20.8°	64
El Paso, Tex.	31° 47'	11.47	6.7°	17.7°	26.9°	16.9°	17.2°	20.2°	64
PROVINCE (D)									
Leh (Tibet)	34° 10' N	3,510M	-7.4°	6.0°	16.3°	5.6°	5.1°	23.7°	69

In the above table there are included one island station (Funchal), one desert station (Yuma) and one station of high altitude (Leh). Although all these stations are located practically on the same latitude, the range of temperature varies greatly, being least at Funchal, and greatest at stations in Eastern Asia. Savannah and Montgomery are correspondingly situated as Nanking on the continent of North American, their range of temperature is much less than that of the latter. This is not due to the high temperature of Nanking in summer, but chiefly due to its low temperature in winter, owing to the intensity of the Siberian anticyclones. Among the stations along the Yangtze River, the continentality increases from coast inland.

8) This figure is according to the Japanese report.

9) Data taken from "Statistical Abstract" U. S. Department of Commerce 1922.

10) Data taken from J. Hann "Handbuch der Klimatologie".

Plate 1 shows the annual march of temperature in Nanking. Very few days in the course of a year, have the diurnal means identical to the mean annual ( $15.2^{\circ}$ ). Temperature increases quickest in the months of April and May, and decreases most rapidly in the month of November.

Table 5 gives the mean monthly and mean annual temperature of Nanking from October 1904 to December 1922.

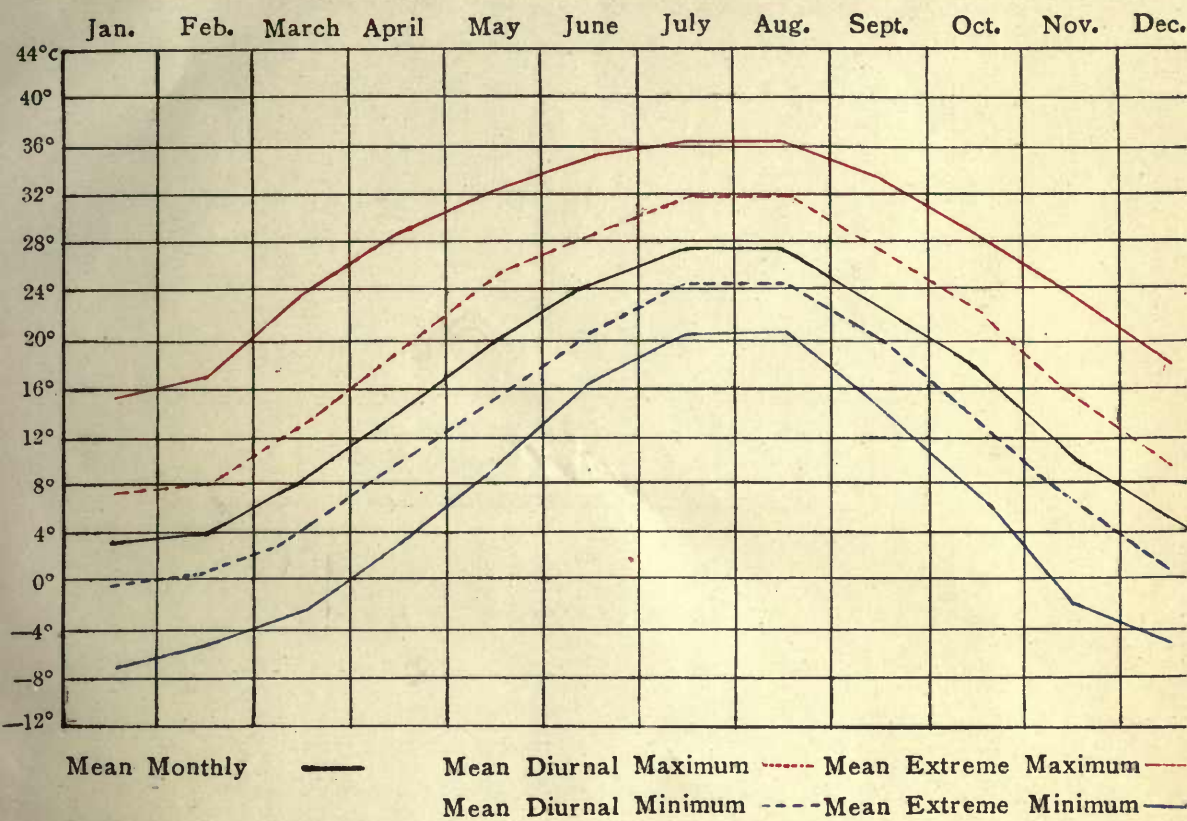
TABLE No. 5

Month Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
1904											9.9	4.4	
1905	4.9	1.8	6.5	12.6	19.3	25.6	28.4	25.8	22.2	16.5	10.4	5.8	15.0
1906	2.6	2.6	9.0	14.7	19.1	23.7	26.9	26.2	22.3	16.6	8.8	5.2	14.8
1907	4.7	2.5	7.6	14.7	21.2	24.1	25.1	27.6	21.9	17.7	10.3	5.9	15.3
1908	3.0	3.4	8.1	12.6	20.5	24.3	27.2	27.9	23.1	17.3	10.2	6.4	15.3
1909	2.4	4.2	6.9	15.7	21.0	22.5	28.0	28.0	24.1	17.3	10.9	4.1	15.4
1910	2.2	2.8	7.6	12.8	18.5	24.1	27.8	27.4	22.0	17.1	11.1	2.9	14.7
1911	2.4	4.0	8.0	14.3	18.9	22.3	29.1	27.1	24.4	16.1	—	—	—
1912	2.1	6.4	7.7	15.5	20.4	25.4	27.3	26.6	21.4	16.9	8.3	3.3	15.1
1913	2.6	4.1	8.2	13.6	19.0	24.4	26.0	27.9	22.5	17.5	10.4	3.5	15.0
1914	5.0	6.1	10.5	13.9	19.1	24.9	30.3	27.2	21.8	17.7	10.9	4.8	16.0
1915	2.9	4.2	8.1	12.9	21.2	25.0	27.5	26.6	21.9	18.3	11.5	6.4	15.5
1916	3.8	4.2	7.8	14.6	19.7	24.1	25.7	26.0	22.7	16.7	10.6	4.1	15.0
1917	0.7	3.8	8.2	16.0	20.7	24.3	27.6	27.3	24.0	16.8	8.7	1.8	14.9
1918	0.5	4.5	8.5	14.0	19.6	24.0	26.6	27.4	23.0	17.5	9.9	5.0	15.1
1919	2.2	4.4	10.1	16.5	21.6	24.6	26.2	27.7	22.1	16.7	9.6	3.8	15.5
1920	3.0*	2.2*	8.4*	13.9*	19.5*	24.2*	27.5*	27.6*	23.7*	18.1*	12.3*	6.3*	15.68*
1921	3.1*	5.9*	9.0*	14.1*	20.3	22.2	27.9	25.5	21.3	15.1	9.6	5.2	14.85
1922	0.5	5.0	8.7	15.6	20.1	24.7	28.1	27.8	21.7	15.7	10.1	5.1	15.55
Mean	2.70	4.02	8.25	14.34	19.98	24.13	27.41	27.08	22.53	17.09	10.18	4.67	15.20

It shows that the annual minimum temperature usually fell on January and annual maximum in July. There were however, three occasions when January was warmer than February, and one occasion (1914) when December was the coldest month of the year. The mean monthly temperature for August was not far behind that of July, and there were seven years out of the total of eighteen when August was hotter than July. The mean minimum and maximum as well as the mean extreme minimum and mean extreme maximum of each month are shown in fig. 1.

\* Data obtained by means of interpolation.

Fig. 1 — Mean Temperature Curves of Nanking.





The lowest temperature so far recorded in Nanking is  $-12.5^{\circ}\text{C}$ . ( $9^{\circ}\text{F}$ ) occurred on the early morning of January 4, 1917. The highest temperature on record is  $40.2^{\circ}\text{C}$  ( $104^{\circ}\text{F}$ ) registered on July 23, 1914. Temperature below  $-10^{\circ}\text{C}$  were also observed in the years 1915, 1922, and 1923. Such low temperatures are rare in other parts of the subtropical belt near the sea level.

As the growing season of the farm crops is limited to the interval between the last frost in spring and the first frost in autumn, it is important to observe these dates.

Table No. 6 Dates of First and Last Frost.

		First Frost in Autumn		Last Frost in Spring	
		Earliest Date	Average Date	Latest Date	Average Date
Hangchow	$30^{\circ}11'$	Nov. 6	Nov. 19	March 31	March 14
Nanking	$32^{\circ}05'$	Nov. 1	Nov. 14	April 6	March 19
Chefoo	$37^{\circ}34'$	Oct. 26	Nov. 7	April 11	March 29
Mukden	$41^{\circ}48'$	Sept. 15	Oct. 2	May 18	May 2

In average there are seven months in a year, from the middle of March to the middle of November, when it is free from frost in Nanking. The period of growing season decreases to five months in Mukden, Manchuria; and increases to twelve in Hongkong, where frost is of rare occurrence.

#### 4. Precipitation

Before discussing the rainfall of Nanking, it will be helpful to know some thing about the general rainfall distribution in the eastern part of the Chinese Republic<sup>(11)</sup>. As would be expected of a region in the monsoon belt, all over China the rainfall maximum comes in summer, and minimum in winter. The amount of mean annual precipitation decreases from south to north, from 2000 mm along the coast of China Sea to 500 mm in Manchuria.

11) For a more detained discussion on the general rainfall distribution, see Author's article on "Rainfall Distribution in China" published in the "Monthly Weather Review" 1916.

There are three rainfall regimes in China; (a) that of north China with a single maximum in the month of July, (b) that of central China or Yangtze Valley with double maxima, one in April and another in June or July, and (c) that of Southern China with double maxima, one in June or May and another in August. A few stations along the coast of the province of Chekiang, south of the Yangtze Estuary, like Hangchow and Ningpo, have a rainfall type which partakes the characteristics of both the types b and c and hence have three maxima, occur in April, June and August. These may constitute a fourth type. All the four types of rainfall regime are represented in Fig. 2

It will be beyond the scope of this paper to give a detailed discussion on all the rainfall regimes<sup>(12)</sup>. Coming back to the rainfall of Nanking, we notice that it conforms to the general Yangtze Valley type (see table 7) with the chief maximum in July and secondary maximum in April. The amount of precipitation fallen during the month of June is not far behind that of July. The Chinese calendar fixed the period from the middle of June to the middle of July to be called the "Mai-ü", which means plum rains (梅雨) or mold rains (霉雨). This "Mai-ü" occurs all over the central part of China and along the eastern coast of Japan. Prof. Okada (岡田武松) of the Japanese Central Observatory describes it in the following words: 'In Japan proper, especially from Kiushiu (九州) to the east coast, we usually have a rainy season beginning towards the middle of June and extending through the first half of July. During this season, the sky remains wholly overcast with clouds and more or less rain falls everyday. The air is so moist that walls, pavements, etc. become damp, and furniture and clothes get moldy. The weather is indeed depressing and unpleasant. This rainy season is commonly called "Mai-ü", meaning the plum rains, as it comes when plums are getting ripe. The "Mai-ü" is the most important period for the cultivation of rice'. The description, although meant for eastern Japan, applies equally well here in Nanking and the whole Yangtze valley.

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<sup>12)</sup> For a general discussion see W. G. Kendrew "The climates of the continents" Chap. 21. Oxford University Press, 1922.

Fig. 2— Rainfall Curves of Nanking, Hongkong, Hangchow, and Tientsin

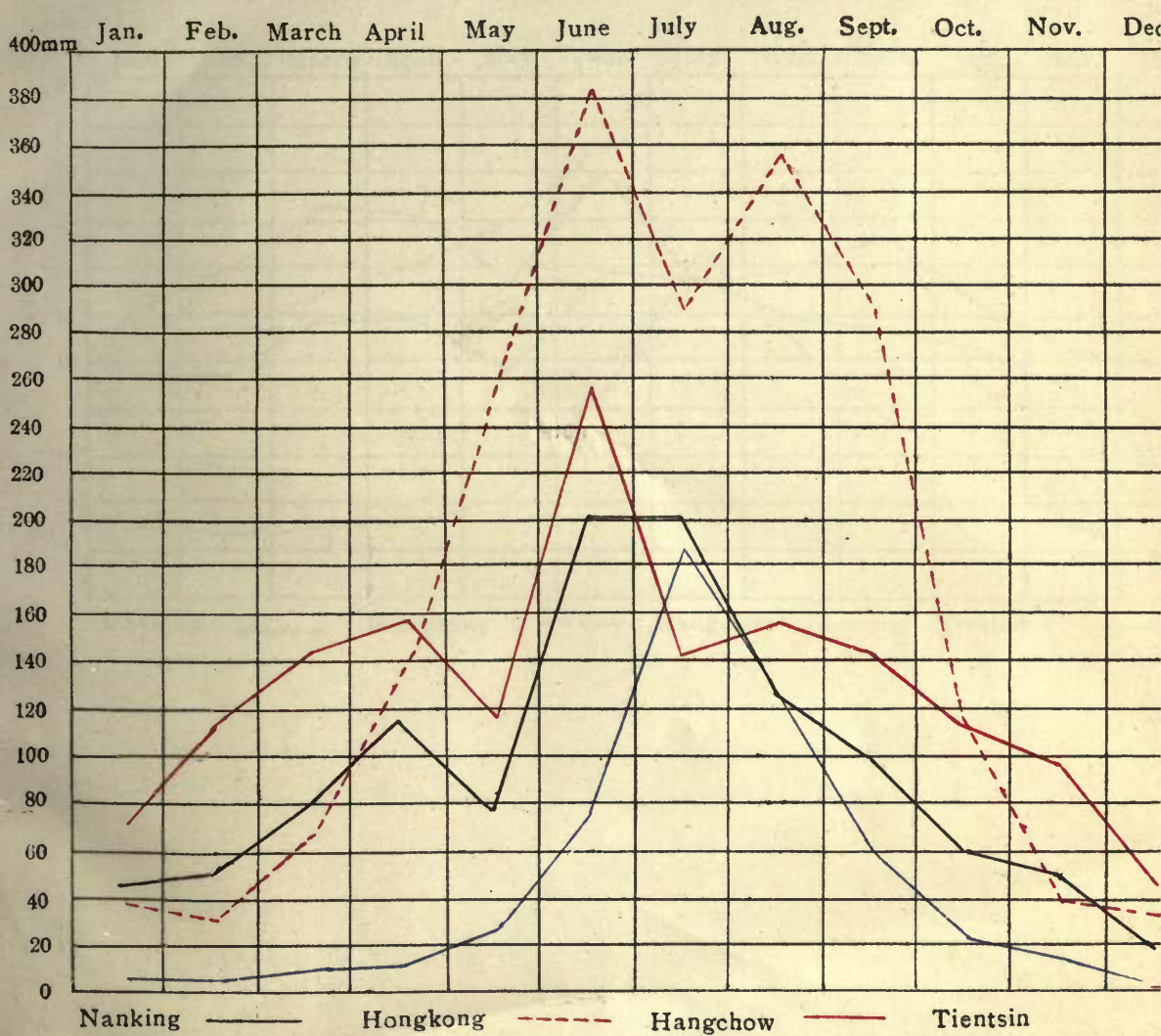




Fig. 3—Rainy Days of Nanking, Hongkong, Hangchow, and Tientsin

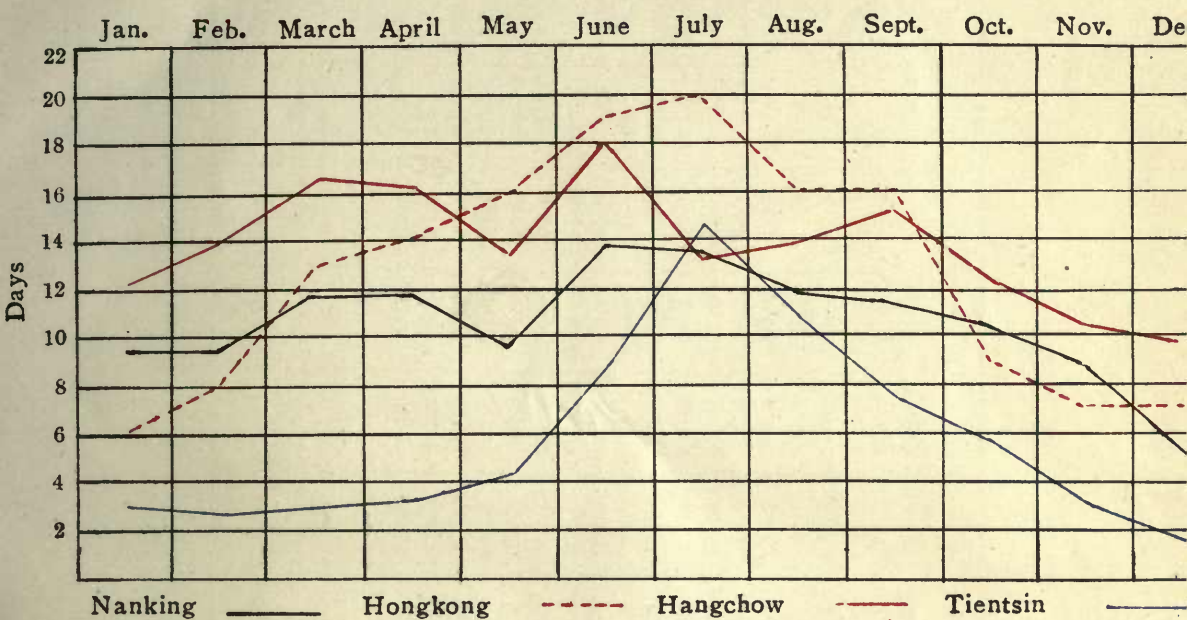




Table No. 7 Mean Monthly and Mean Annual Precipitation of Nanking

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1904													
1905	90.9	27.3	120.2	100.5	90.8	81.2	240.6	174.6	161.2	82.5	23.0	32.7	1264.4
1906	66.2	103.1	41.2	63.7	137.0	164.5	314.6	343.7	118.5	11.7	10.1	84.4	402.9
1907	69.2	21.5	86.0	34.9	38.5	51.3	270.7	183.2	86.2	111.1	18.2	20.5	1047.0
1908	51.4	20.5	29.9	109.7	51.0	213.6	197.6	7.5	71.0	106.3	16.8	6.2	893.4
1909	56.3	10.5	101.5	18.1	14.7	371.6	287.3	48.8	65.3	55.9	24.8	33.2	1088.0
1910	91.7	20.1	191.7	121.3	75.6	248.8	206.1	109.8	174.4	13.3	35.3	23.8	1311.9
1911	59.5	47.5	104.2	172.2	93.1	201.4	368.6	196.8	119.7	15.4	—	—	—
1912	17.4	54.5	85.2	93.3	63.6	201.7	192.8	128.0	40.1	29.0	110.7	40.3	1007.2
1913	12.2	11.4	25.8	160.9	71.2	141.8	74.7	0	30.8	0	29.0	18.4	576.2
1914	9.0	85.9	50.7	164.6	136.8	68.5	24.3	125.2	206.8	52.1	51.5	8.5	573.9
1915	19.8	124.4	67.7	190.4	94.4	406.9	201.6	116.9	80.2	202.6	115.7	0.7	1621.3
1916	13.9	62.7	18.2	89.9	146.2	259.8	276.4	147.9	63.9	81.8	37.4	14.2	1212.3
1917	6.0	7.3	15.9	13.9	26.5	258.1	147.0	88.2	34.2	29.7	45.2	2.1	674.1
1918	0	35.5	52.6	89.2	75.7	96.1	302.7	88.4	36.8	41.7	72.2	105.5	996.4
1919	39.7	10.2	119.2	75.6	43.8	225.7	228.1	27.4	57.3	11.0	26.0	16.1	881.1
1920	43.4	75.6	115.7	107.8	53.0	71.7	210.5	85.5	125.8	10.3	5.5	103.3	1007.5
1921	3.4	31.0	40.2	152.3	55.4	196.4	200.8	265.0	174.2	45.4	12.6	8.2	1184.9
1922	61.8	82.5	38.3	23.5	59.3	137.7	71.7	114.0	241.6	33.9	20.3	2.0	886.7
Mean	39.54	46.20	72.46	99.60	73.70	188.68	209.23	125.08	104.89	51.87	40.14	29.90	1081.27

\*Data obtained by means of interpolation

Conditions similar to "Mai-ä" occur also in the month of April in Nanking, thus causing two rainy seasons in a year. This explains the secondary rainfall maximum in April. The "Mai-ä" is probably due to the fact that winds coming from southeastern direction, are chilled by travelling northwestward, and thus saturated with moisture causing continual and heavy rains. The high sun in midsummer, however, increases the temperature of the air so much so that it is able to absorb the surplus moisture. Hence by the middle of July weather becomes less rainy and fine intervals more frequent.

Another reason for the maximum rainfall in the months of April and June, as pointed out by Prof. Okada, is because of the great number of storms passing through the Yangtze Valley during these two months. The writer has computed the number of depressions occurred in the Yangtze Valley during the period 1901-1910, and found that they are most frequent in April and June and least in August as the following table shows<sup>(13a)</sup>:—

Table 8a—No. of Depressions occurred in the Yangtze Valley in the period 1901-1910

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
No. of Storms	23	16	21	25	19	26	8	2	5	11	9	12	177

In China, the summer monsoon is not so strong nor so steady as the Indian monsoon. The latter probably reaches to a higher altitude also. In India the "burst" of monsoon in June causes a drop of mean temperature of that month, and makes May the hottest month of the year. In China no such drastic effect can be perceived.

This, however, does not mean that the amount of precipitation in summer has no influence on temperature whatsoever. In Nanking, even in August, when most of the rain is brought about by typhoons and local thunderstorms, the correlation between the mean monthly temperature and amount of rainfall is still quite large as shown in figure 4 and table 8.

13a) This table is taken from the author's article on "The Rainfall Distribution in China" published in Monthly Weather Review, 1916.

Fig. 4—Showing the Correlation Between Mean Temperature  
 And Mean Rainfall' for the Month of August, 1905 - 1922  
 Red Line Represents Temperature  
 Blue Line Represents Rainfall

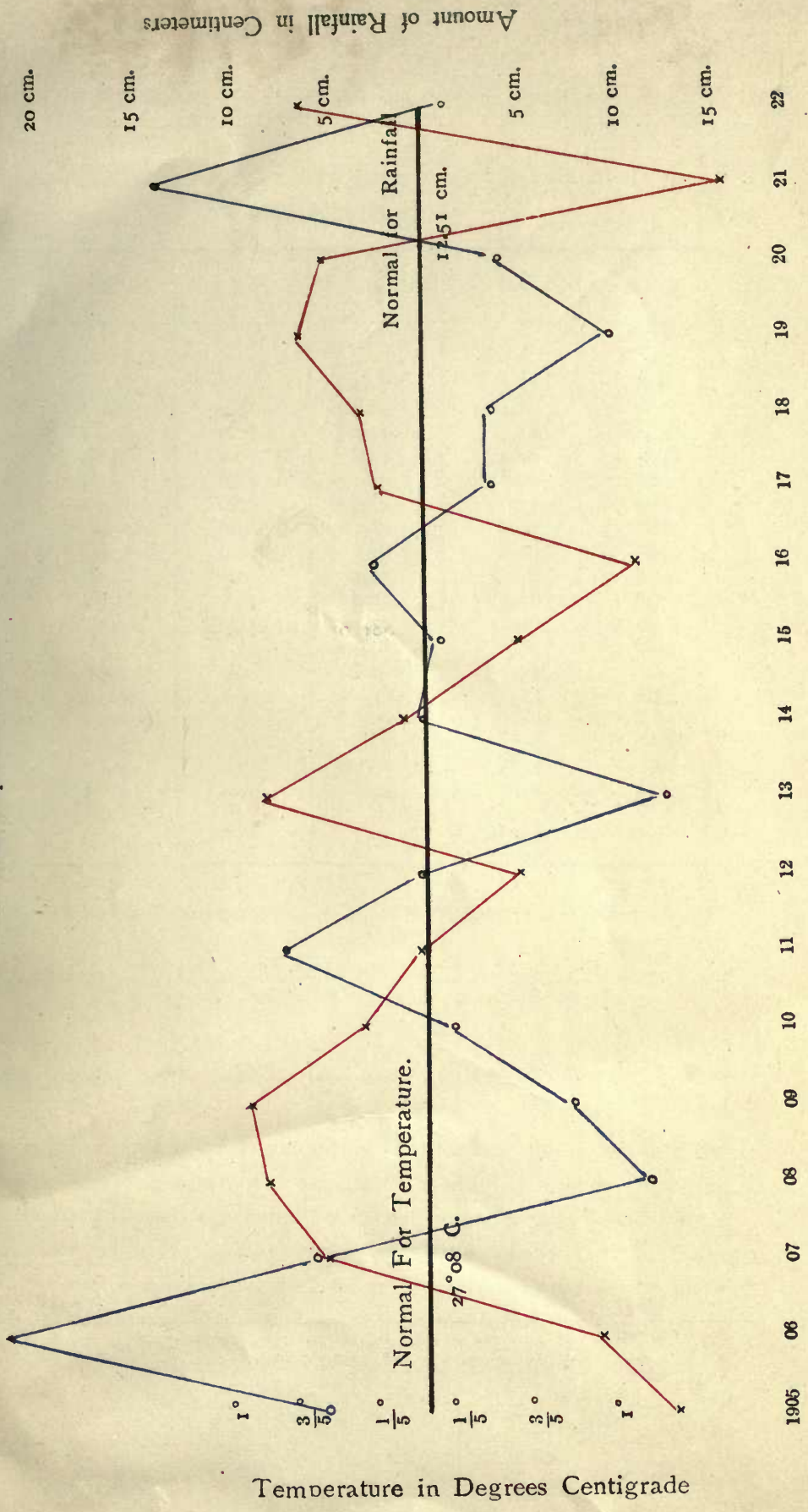




Table No. 8 Correlation between temperature and Rainfall of Nanking in August.

Year	A	A <sup>2</sup>	B	B <sup>2</sup>	A×B
1905	-1.3°C	1.69	+1.97"	3.87	- 2.56
1906	-0.9	0.81	+8.62	74.10	- 7.76
1907	+0.5	0.25	+2.28	5.19	+ 1.14
1908	+0.8	0.64	-4.64	21.50	- 3.71
1909	+0.9	0.81	-2.99	8.92	- 2.69
1910	+0.3	0.09	-0.59	0.35	- 0.18
1911	0.0	0.00	+2.83	8.00	0.00
1912	-0.5	0.25	+0.16	0.26	- 0.08
1913	+0.8	0.64	-4.92	24.16	- 3.94
1914	+0.1	0.01	0.00	0.00	0.00
1915	-0.5	0.25	-0.31	0.96	+ 0.16
1916	-1.1	1.21	+0.91	0.83	- 1.00
1917	+0.2	0.04	-1.46	2.13	- 0.29
1918	+0.3	0.09	-1.46	2.13	- 0.43
1919	+0.6	0.36	-3.86	14.88	- 2.32
1920	+0.5	0.25	-1.57	2.46	- 0.78
1921	-1.6	2.56	+5.51	30.35	- 8.82
1922	+0.6	0.36	-0.43	0.18	- 0.26
Total		10.31		200.27	-33.52

A=Departure in Temperature

B=Departure in Rainfall

$$\text{Correlation Coefficient} = \frac{\sum AB}{\sqrt{\sum A^2 \cdot \sum B^2}} = \frac{-33.52}{\sqrt{10.31 \times 200.27}} = -0.738$$

$$\text{Probable Error} = 0.674 \sqrt{\frac{1 - (0.738)^2}{18}} = 0.0725$$

In order to find the correlation coefficient which may exist between the mean monthly temperature and amount of rainfall of August, table No. 8 was constructed, and a negative coefficient of 0.738 was found with a probable error of 0.0725. This large correlation shows the fact that although the control of rainfall over temperature is not apparent by mere inspection, the potential influence exerted on the former by the latter is still quite important.

In September heavy precipitation sometimes occurs when there is a typhoon passing near by Nanking. From October to March most of the precipitation falls as cyclonic rainfall. Only 27.5% of the mean annual rainfall falls during the winter six months from October to March. But in north China, the percentage of precipitation fallen during the winter half year, is still less, the amount decreases to 10.7% in Tientsin.

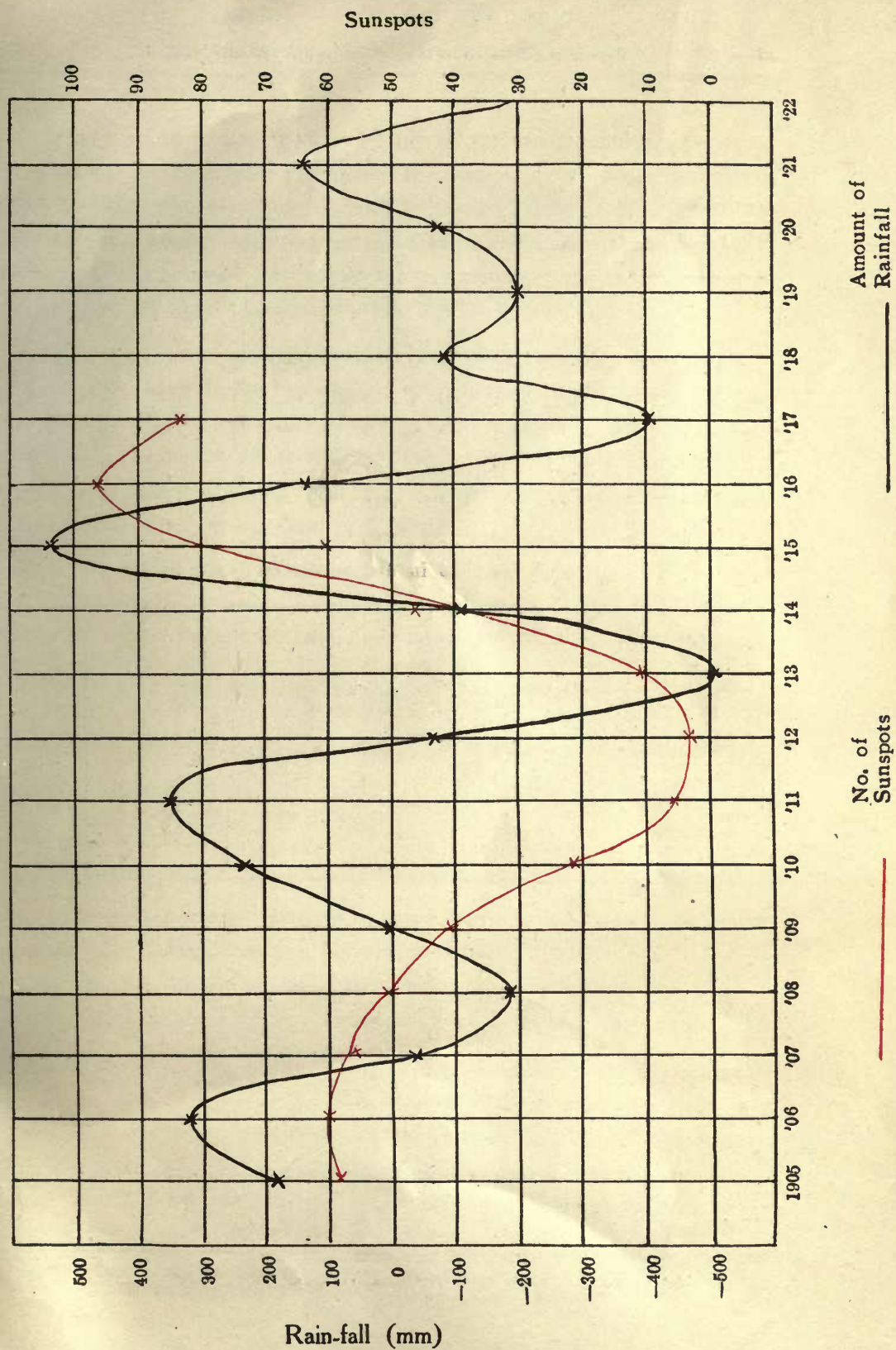
There is one peculiarity in the cyclonic rainfall of Nanking which needs to be mentioned, that is, the precipitation is always heavier on the rear side of a cyclone than on the front. The pressure gradient around the low is not symmetrical, much steeper on the rear side than on the front. Before the coming of the storm the pressure decreases gradually, and precipitation often does not occur until the approach of the storm center. Suddenly wind changes in direction and increases its strength, and at the same time precipitation falls with greater intensity. This same phenomenon seem to be true at Hankow. Mr. Stanley V. Boxer of Meteorological station of Griffith John College, writing on the "Barometric Height of Hankow, said<sup>(13)</sup> "The worst weather, wind or rain, seems always to occur not when the glass is falling, but just after it has begun to rise after a rapid fall." In the light of the new Norwegian theory of "Polar Front", it may be said that most of the precipitation of Nanking or Hankow occurs as "cold sector" rains. This phenomenon probably holds true for all stations in the lower Yangtze Valley

Table No. 7 shows the mean annual and mean monthly rainfall of Nanking from October 1904 to December 1922. The variability of the amount of precipitation from one year to another is quite great, the mean variability being 11%. The mean annual for 1915, the wettest year on record, was 1621.3 m.m., or 160% of the mean; while that of the preceeding year amounted only to 571.9 m.m., or 51% of the mean, just about one third the amount of 1915. The fluctuation of mean monthly was still greater. In August of 1921 there was 265 mm. of precipitation, while in the same month of 1913 there was none at all.

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13) Meteorological Survey for 1918, p. 14, Hankow, 1919

Fig. 5 — Variation of Number of Sun Spots and Abnormality of Rainfall in Naking





There seems to be a periodicity in the variation of the mean annual, with a period of about five years; thus the maxima occurred on 1906, 1911, 1915 and 1921; while the minima fell on the years 1908, 1913, 1917, 1919 and 1922 (the amount of precipitation in 1923 was greater than in 1922). The mean annuals have been plotted along with the number of sun spots<sup>(14)</sup> in Fig. 5 and no close connection is found between the two.

A part of the precipitation during the winter months comes as snow. But since the winter is the dry season, the snowfall never amounts to very much. Usually after a snowstorm, snow covers the ground only for a day or two, then disappears. The following table gives the dates for the first snowfall in Autumn and the last snowfall in Spring based on the data observed during the period from 1905 to 1915.

Table No. 9 Dates of First and Last Snowfall.

Place	Latitude	First Snowfall in Autumn		Last Snowfall in Spring	
		Earliest Date	Average Date	Latest Date	Average Date
Nanking	32°05'	Nov. 9	Dec. 7	April 3	March 14
Hangchow	30°11'	Nov. 9	Dec. 8	March 15	Feb. 23
Chefoo	37°34'	Nov. 2	Nov. 11	April 24	March 25
Mukden	41°48'	Oct. 5	Oct. 28	April 28	April 9

In comparison with stations situated on the same latitude along the east coast of North America, Nanking is drier in winter and wetter in summer. In the following table the amount of precipitation and number of rainy days of Nanking are compared with those of Charleston, S. C., approximately on the same latitude but nearer the coast.

TABLE No. 10  
Amount of Precipitation

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year.
Nanking	32°05'	39.5	46.2	72.5	99.6	73.7	188.7	209.2	125.1	104.9	51.9	40.1	30.0	1081.3
Charleston	32°47'	75.0	75.0	80.0	60.0	85.0	130.0	150.0	161.0	130.0	99.0	66.0	84.0	1216.0

14) The data on sun spots are taken from prof. A. J. Henry's "Variation in precipitation and sunspots" Monthly Weather Review, March, 1922, pp. 127-131.

### Number of Rainy days

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Nanking 32°05'	9.4	9.4	11.9	11.9	9.3	13.8	13.5	9.9	11.5	10.5	8.8	5.4	125.3
Charleston 32°47'	10	10	10	8	9	11	12	13	10	8	8	9	118.0

### 5 Relative Humidity

The relative humidity of a place depends upon to a great extent on the amount of rainfall. In Nanking, the relative humidity is comparatively small in winter, increases a little in April but decreases again in May. The onsetting of "The Mai-Ü" in June however, causes an increase of more than three percent. In July the relative humidity reaches its maximum with 83 per cent. After July the relative humidity declines until the minimum is reached in December.

As a whole the annual march of relative humidity in Nanking bears a close resemblance to that of Charleston as can be seen in the following table. The mean annual is one percent greater in Nanking.

Table No. 11 Relative Humidity

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Nanking	77.9	77.8	77.6	77.8	77.7	81.0	83.0	81.0	81.0	78.0	78.0	76.0	79.0
Charleston	77.0	76.0	75.0	76.0	77.0	79.0	80.0	81.0	80.0	76.0	77.0	79.0	78.0

But even in winter when the amount of precipitation is small, the relative humidity in Nanking is still great. At Peking the relative humidity in winter months amounts to only 59 percent. People coming from North China often find the winter in Nanking much colder than what they expect, because of the high vapor content, and hence high conductivity of the atmosphere.

### 6 Cloudiness.

The data on cloudiness are very meagre. The following table is also based upon the information from the Japanese sources, covering the period 1905-1915. Days with cloudiness below 2/10 are called clear days, while days with cloudiness over 8/10 are called cloudy days. The term

partly cloudy is used to designate an amount of cloudiness between  $3/10$  and  $7/10$

Table No. 12 Number of Clear and Cloudy Days in Nanking

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Clear Days	7.3	3.9	5.0	3.8	5.2	2.1	4.1	3.2	4.0	6.6	8.8	10.4	64.4
Cloudy Days	11.8	13.0	13.3	13.3	12.3	14.7	12.5	9.1	13.5	11.6	10.7	8.9	144.7

The Sky is brightest in the month of December, through the rest of the year there are more cloudy days than there are clear days in every month. June is the most gloomy month of all. Even in winter, the dry season of the year, the sky is overcast one third of time.

## 7. Wind.

The information on wind in Nanking is also very meagre. The wind components in the different seasons of the year among places along the lower Yangtze Valley do not differ from each other very much. Table No. 13 shows the percentage of wind directions of different months at N. Saddle Island, a station at the mouth of the Yangtze Valley. While it can not fully represent the wind conditions in Nanking, it gives an idea of the change of wind directions from month to month along the coast of Eastern Sea.

According to the table, the wind is northwesterly in the month of January, then gradually veers as the season advances until July it comes mainly from southerly quarter. After July the wind backs through SE, NE and finally returns to NW again in December. It should be noticed that in April the wind is very steady, east-northeast wind predominating; while in May the wind is less steady in direction than either April or June. ~~This fact may have something to do with the secondary minimum in the annual precipitation, occurred during the month of May all along the lower Yangtze Valley.~~

Table No. 13 Wind Components at N. Saddle Island<sup>(15)</sup>

	Jan.	Feb.	Mar.	Apr	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
N	12	9	9	5	4	2	1	4	9	10	11	11
N.NE	10	12	10	7	6	3	2	5	12	12	11	9
NE	9	11	10	16	6	4	3	5	13	15	10	7
E.NE	6	8	9	24	6	4	4	5	11	12	7	4
E	4	6	7	15	6	6	5	6	9	9	6	3
E.SE	4	6	8	10	9	11	11	11	9	9	6	4
SE	5	5	8	11	12	16	16	16	9	7	5	4
S.SE	3	3	6	10	11	13	17	14	6	4	3	4
S'	2	2	4	8	9	12	17	11	4	1	2	2
SSW	3	2	4	7	8	11	13	8	3	1	2	3
SW	3	2	4	5	6	8	7	5	2	1	3	3
WSW	3	2	2	3	3	3	2	2	1	1	2	2
W	4	1	1	2	1	1	0.5	1	1	1	2	2
WNW	7	4	3	2	2	1	0.5	1	1	3	6	9
NNW	13	7	6	4	3	1	1	2	3	5	11	17
NNW	14	7	8	5	4	2	1	3	6	7	12	15
Calm	0.3	0.3	0.2	0.5	0.2	0.8	0.1	0.5	0.3	0.6	0.6	0.4

15) Père H. Gauthier "La Temperature en Chine" Vol. I, Part 2, article 1. This table is based on 16 years average. The latitude of N. Saddle Island is 30°52'N.



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